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Impact of Nutrition Intervention Programme on Performance of High School Kabaddi Players

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ABSTRACT The present study was undertaken to study the impact of nutrition education and carbohydrate supplementation on performance of high school kabaddi players of Dharwad, Karnataka. Players were divided in to two groups as control and experimental. Both the groups were assessed for physical measurements, physical performance, nutrient intake and nutrition knowledge, practice before the intervention. Experimental group received nutrition education for 12 contact hours. Later they were supplemented with carbohydrate rich snack (Carbohydrate –72gm) three days before the final match. On the day of competition experimental group received a carbohydrate (6.75%)electrolyte beverage before, during and after the competition. Physical performance was evaluated using AAHPERD physical fitness test. Real match was arranged between control and experimental group to evaluate the field performance. The findings of impact of nutrition education revealed that overall nutrition knowledge level increased significantly by 35% where as practice was improved only 13%. The knowledge improvement was better than practice. Carbohydrate intake after the nutrition education was 70%. This was further improved due to carbohydrate supplementation to 73%, which was significantly more than control group. The physical performance results revealed significant improvement in the selected fitness tests like strength by 12 cm, agility by 1.5 sec, endurance by 432 mts. There was significant improvement in the game performance as evaluated by coaches in experimental group (7.6) and in control group (4.2) and experimental group had won the match. Self-evaluation of performance by players showed intervention program was useful for their sports performance.

INTRODUCTION

When talented, motivated and highly trained athletes meet for competitions the margin between victory and defeat is usually small (Ron Moughan, 2002). The importance of dietary carbohydrate before exercise or during competition is well established. Total body carbohydrate stores are limited and often less than the carbohydrate requirements of athletic training and competition. The availability of carbohydrate as a substrate for muscle metabolism is a critical factor in the performance of high intensity, intermittent work. (Burke, 2001). Muscle and liver glycogen levels are relatively small and are reduced during training and competitions (Murray et al., 1998). The majority of energy released during muscle work is derived from carbohydrate and fat. At higher exercise intensities carbohydrate is the most important fuel source (Brouns, 1993). Maintaining good dietary supply of carbohydrate becomes increasingly important to exercising athletes. Research has shown that athletes who eat a generous supply of dietary carbohydrate are better able to maintain their carbohydrate stores and maintain strenuous physical activity.

Costill (1988) recommended that athletes ingest 9-10g of carbohydrate per kg body weight per day. Student athletes should consume a diet in which at least 60% of the total energy is supplied by carbohydrate (Costill, 1992). Pre exercise carbohydrate loading has been shown to improve performance (Costas and Williams, 1997), but studies with respect to pre exercise carbohydrate loading on team games are not available

According to Burke (1995), a student athlete may not be adequately nourished due to poor understanding of sports nutrition principles, lack of practical nutrition knowledge and practice. Hornak (1997) stated that nutrition education is a key element in promoting life long healthy eating and exercise behaviors.

In India very few studies are conducted in the field of sports nutrition and its impact on the performance level. Kabaddi is an Indian national game. The game Kabaddi essentially needs little equipment and expenditure unlike cricket and tennis. The essential skills for Kabaddi are offensive skills and defensive skills. Raid is the character of the Kabaddi. Game is played by seven players and of twenty minutes set duration .The game goes as follows namely pre- consideration of raid, taking cant and entry,

tracing the path, foot work, attacking tactics, returning back (Ogennaver and Bujurke,1996). This game involves both speed and endurance with strength of specific group of muscles and neuro muscular coordination.

Information regarding nutrition, nutrient intake and impact of supplementation in relation to specific team games is not available. Hence the present study was undertaken with the objective to find out the impact of nutritional intervention package, which consisted of nutrition education and carbohydrate supplementation on the performance of high school Kabaddi players.

MATERIAL AND METHODS

Selection of Subjects: Twenty-four boys representing two teams studying in ninth and tenth standard (14-16 years) were selected from two schools of Dharwad City, Karnataka. They were participating in Kabaddi competitive matches at school, inter school and district levels. Each team consisted of 12 members consisting of 7 + 5 reserve players. Players from one school were considered as control group (12 boys) and another 12 students from other school represented experimental group.

ASSESSMENT OF PHYSICAL ATTRIBUTES

Body Measurements and Hemoglobin: The subjects were measured for their standing height by using Anthropometric rod and body weight by weighing scale. Mid arm and chest circumferences were measured using fiber tape. Skin fold measurements were obtained from two sites of the body, i.e. triceps, biceps with the help of the standard skin fold calipers (Lange-Cambridge scientific industries Cambridge, Maryland USA). All the measurements were carried out as per the guidelines of Jellife (1966), Rao and Vijayaraghavan (1996). Lean body mass and percent body fat was computed by using predicted formula Deurenberg et al (1991). Hemoglobin was estimated by cyanmethemoglobin method as recommended by WHO (1966)

Measurement of Physical Performance: Physical Fitness Tests: AAHPERD (American Alliance for health, physical education, Recreation and Dance.) Physical fitness tests were used for the measurement of physical performance. Physical test (AAHPERD Test Manual, 1980), which measures speed, agility, strength, flexibility and endurance, was selected for the present study. Speed was measured using 50-meter dash. Agility was measured in seconds using 20-metre shuttle run. Time was measured to the nearest of $1/10^{th}$ of a second by a hand held stopwatch. Strength was measured using vertical jump, Flexibility was measured using forward bend test, and they were measured using fiber tape in cm. Seven minutes walk or run was used to measure endurance and the distance covered by the subject was noted down in meters. All the above-mentioned tests were conducted before the intervention programme. Subjects were given two practices before the beginning of the test.

Assessment of Nutrition Knowledge and Practice: A Checklist type of questionnaire was selected, as it is reliable method to elicit information to assess nutrition knowledge and practice. A proforma was formulated to elicit information on nutrition knowledge and practice of football players. The questionnaire was validated by a panel of experts in the field of nutrition, physical education, and sports nutrition and was modified according to their recommendations. The questionnaire was also pre-tested for clarity with a group of individuals similar to the study participants.

The first part of the instrument sought information about the knowledge on general nutrition. The second part of the instrument included about knowledge on sports nutrition. The third part elicited information on food practices pertaining to general and sports nutrition. A total of 46 questions were included in the questionnaire. Each correct answer was given one score. The questionnaire was administered to both the groups before the intervention programme.

Assessment of Nutrient Intake: Diet survey was carried out for one day to assess actual intake of two groups before the intervention programme using 24-hour recall method and seven days after the intervention, before the competition. Nutrient intake was computed using dietary intake based on a ready recknor developed by the investigator for nutritive value which was developed on the guidelines of Thimmayamma (1996), using standardized cups and ICMR (Indian Council of Medical Research) tables.

Tools and Techniques Used for Nutrition Education: Nutrition education programme as a first component of intervention programme was

carried out for experimental group for a period of three months, which consisted of twelve contact hours at the rate of one contact hour /week. The contact classes included lectures on general nutrition, sports nutrition using exhibition and power point presentations. The subjects were evaluated before and after the nutrition intervention programme using a checklist as mentioned above.

Methodology Adopted for Carbohydrate Supplementation and Performance: Carbohydrate loading as suggested by Hoffman (1991) includes intake of 350-550gram of carbohydrates (70% of total calories) during the last 72 hours proceeding to the competition. This loading helps to increase 20-40% of glycogen stores above the normal level and later utilized during the competition period Coyle (1995). This method of carbohydrate loading was followed for the present study as a second component of intervention programme.

Total carbohydrate loading or supply of meals for all the players for 72 hours or three days for two trials before the event was found to be very difficult. Therefore it was planned to supplement carbohydrate through a snack item to add on to the normal diet consumed by the players to reach a desirable load of carbohydrate for the experimental group. The amount of carbohydrate to be supplemented in the form of a snack was computed based on the diet survey, which was carried out before the intervention. For the purpose of carbohydrate supplementation Laddu, a traditional snack item was selected. Preparation of laddu was standardized using refined wheat flour and underutilized foodstuffs like amaranth seeds, garden cress seed and groundnuts, jaggery, oil. One serving of laddu (two -103g) contained 72g of carbohydrate and provided 416 Calories. Acceptability trials were carried out for the developed product with the help of 15 trained panel members. An additional supplementation of carbohydrate in the form of two laddus was provided (72g of carbohydrate and 412 kcal) per day to experimental group to elevate the carbohydrate level to more than 300 g, which was a desirable level of carbohydrate supplementation before the event, for three days continuously prior to the competition, and they consumed the laddu (during practice time) in addition to the usual diet taken at home as carbohydrate supplement.

It is also stated that there was a need for quick energy and electrolyte supplementation, if the game exceeds more than one hour during the competition (Convertino et al., 1996). Since kabaddi match usually takes more than one hour, it was planned to provide sport drink for the players during and immediately after the competition. A drink was prepared and standardized using kokum peels (*Garcenia indica*), soaked rice flakes and sugar for supplementation during the competition. One serving of drink supplied 6.75% of carbohydrate and fortified electrolytes (Sodium: 10mM/L, Potassium: 5mM/L) as stated by Martin (2003).

A sports drink was also provided during the competition day for experimental group. Experimental group received 250 ml of drink (5ml / kg body weight) before the event and another 300 ml was given during the event (3ml /kg body weight). After the event, 250 ml (5 ml/kg body weight) of drink was provided.

Organization of Real Matches: The approach of evaluating the real match situation as suggested by Burke (1999) was selected for the present study to find out the impact of carbohydrate supplementation on field performance of players. The experimental group was supplemented with two laddus before the event for three days as explained earlier. The real match was organized between control group and experimental group who received carbohydrate supplementation and also nutrition education with the assistance of school authorities and coaches. On the day of competition, the players were asked to report to the field at 9 am. They were asked to take light breakfast, which is rich in carbohydrate and low in fat before 7 am. Before the real match, the physical performance tests were conducted and the match started at 10.30 am. Each match was played for two or three games depending on the result and the duration of one game. The practice time was maintained uniform for both the groups for one hour. The experimental group was advised to reduce the practice for 30 minutes during supplementation. Two trials of kabaddi matches were organized with a gap of fifteen days.

EVALUATION OF INTERVENTION PROGRAMME

Nutrition Knowledge and Practice: A Checklist, which was used to assess the knowledge and practice level before the intervention programme was also used to find out the impact of nutrition education. After three months of nutrition education, both the groups were assessed for nutrition knowledge and practice.

Nutrient Intake: Diet survey as mentioned earlier was used to assess the impact of nutrition education and carbohydrate supplementation on nutrient intake for a period of seven days including three days of with and without carbohydrate supplementation and the match day.

Physical Performance: Physical performance was evaluated by AAHPERD test as explained earlier. All the tests were conducted after carbohydrate supplementation and before the competition.

Field Performance: There are no standardized techniques used in research to evaluate sports performance in team games because it involves complex mixture of physical fitness and mental skills. In the absence of any standard method to quantify field performance of the team games, a checklist was evolved with scoring method. This checklist was formulated with the help of experts in the field and checked for its validity. A checklist was prepared to evaluate game specific skills like offensive and defensive skills, over all performance of players and number of fouls observed during the match. Three invited coaches evaluated performance of players. They were briefed about the evaluation of each individual player during the competition. The experts were unaware of the control and experimental group and they evaluated them, using the checklist with a maximum score of ten. The experimental group also evaluated about their field performance after competition using another formulated checklist. Field performance was evaluated after two trials of real matches.

RESULTS AND DISCUSSION

Physical Measurements and Hemoglobin of Kabaddi Players: It is clear from the Table 1 that the physical measurements and hemoglobin were similar in both control and experimental group except in mid arm circumferences, lean body mass and percent body fat. Although there was significant difference in some measurements, but variation was very meager. The selection of Kabaddi teams for the study was carried out with the help of the physical education teachers. Thus the players were not matched for all the physical attributes. However, it is interesting to note that both the team players were essentially similar in other physical attributes as illustrated in table 1.

Nutrient Intake of Kabaddi Players Before Intervention: Table 2 reveals the nutrient intake of Kabaddi players before intervention. The percentage of carbohydrate intake from calories was 58 and 57 respectively in control and experimental group. The nutrient in take of both the groups was similar.

Table 1: Physical attributes of Kabaddi players

Physical attributes	*Control (n -12)*	*Exp (n -12)*
Height (cm)	162.3±3.4	161.4±3.4
Weight (kg)	46.3±2.8	45.6±6.3
Body mass index	17.5±1.0	17.6±2.6
Mid arm circumferences (cm)	23.3±1.5	26.1±1.8**
Chest circumferences (cm)	74.8±2.5	76.1±4.9
Biceps (mm)	3.4±0.5	3.7±1.0
Triceps (mm)	6.0±0.2	6.29±0.6
Hemoglobin (g /dl)	11.0±1.0	11.4±2.2
Percentage body fat	12.2±1.4	14.0±2.0**
Lean body mass (kg)	40.0±2.2	39.4±4.9*

t result ** significant at P<0.01level, * significant at P<0.05 level

Impact of Intervention Programme

Nutrition Knowledge and Practice: It is evident from Table 3 that the control and experimental group scored 40-52% for knowledge and 37-41% for practice, before the intervention programme. After imparting nutrition education, the experimental group showed significant improvement in general, sports and over all nutrition knowledge and practice. It is interesting to observe that the level of improvement was more in knowledge than in practice. The overall knowledge gain was 35% where as gain in practice was only 13 %. See table 3 for details. The positive outcomes of intervention could be attributed to the fact that students were interested in improving their performance by understanding better knowledge and practice in general and sports nutrition. These findings are in agreement with the results of studies in nutrition education carried out for elementary school children, Manios et al. (1999) and Long (2004).

Impact of Nutrition Education on Nutrient Intake: It is pertinent to mention here that the calorie and carbohydrate intake of both experimental (253g) and control groups (257g) were similar before intervention programme (see Table 2). Therefore, the impact of nutrition education was assessed in experimental group and compared with control group after intervention programs shown in Table 4.

Table 2: Nutrient intake of Kabaddi players

Nutrient	*Control (n-12)*	*Experimental (n-12)*
Calories (Kcal)	1736±95	1781±150
Protein (g)	51±16	54±12
Fat (g)	47±6	42±7
Carbohydrate (g)	253±25	257±32
CHO (% of calories)	58	57

t result: : ns for all nutrients.

Table 4 shows the mean of three-day dietary intake of two groups. There is a significant difference in the intake of calories and nutrients namely protein, fat, carbohydrate, between the groups. It is also note worthy to mention here that the experimental group selected foods rich in carbohydrates like roots and tubers, more of cereals servings. This clearly indicates that nutrition education has improved the carbohydrate intake

Impact of Carbohydrate Supplementation on Nutrient Intake Before the Competition: There is a significant increase in carbohydrate intake in experimental group, as shown in Table 5. It is very much evident that the intake of carbohydrate before the intervention was 57% and this was elevated to 70% after education (see table 4) and carbohydrate supplementation further increased the carbohydrate intake to 73% (Table 5). This level of carbohydrate loading (70%) in the present study was similar, as advocated by Hoffman et al (1991). Carbohydrate intake soon after the event is as important as before and during the event so as to replenish the muscle glycogen. In the present study, it was observed that experimental group recorded intake of 83% of Calories from carbohydrates on the day of the match and soon after the event, which was at desirable level to replenish the glycogen storage. This clearly indicates that nutrition education and supplementation has improved the carbohydrate intake

Physical Performance: It is evident from Table 6 that carbohydrate supplementation did improve all the physical performance parameters

Table 3: Nutrition knowledge and practice of Kabaddi players

	Control (n -12)		*Experimental (n -12)*	
	Before NE	*After NE*	*Before NE*	*After NE*
General nutrition - K (Max score=21)	8.3±2.1(40)	9.2±2.2(43)	9.1± 4.7(43)	16.5±3.3**(79)
General nutrition - P (Max score=15)	6.2±1.2(41)	6.3±1.0(42)	5.5± 1.0(37)	6.8±1.3*(45)
Sports nutrition - K (Max score=05)	2.6±0.9(52)	2.5±0.4(51)	2.57± 0.81(51)	4±1.0**(80)
Sports nutrition- P (Max score=05)	2.0±0.4(40)	2.0±0.1(40)	1.9± 1.1(38)	3.2±1.0**((64)
Overall- K (Max score=26)	10.9±1.8(42)	11.7±1.6(45)	11.7± 4.6(45)	20.7±3.6**(80)
Overall- P (Max score=20)	8.2±1.3(41)	8.3±1.0(41)	7.4± 1.0 (37)	10±1.1**(50)

Figures in parenthesis indicate percentage t test result = * * Significant at P<0.01 level.
* Significant at P<0.05 level.

Table 4: Nutrient intake after nutrition education programme (Mean of 3 days)

Control (n-12)		*% of calories*	*Experimental (n-12)*	*% of calories*
Calories (Kcal)	1757±136	-	2204±173**	-
Protein (g)	52± 5	12	59±3**	11
Fat (g)	65± 4	33	47±8**	19
Carbohydrate (g)	241± 20	55	386±23**	70

t test result ** = Significant at P<0.01 level.

Table 5: Nutrient intake before, during and after the real match.

	Control group		*Experimental group*			
	Mean 3 days	*% of calories 1*	*Mean 3 days CHO sup*	*(%)of calories 2*	*Match day-drink sup*	*(%) of calories 3*
Calories (Kcal)	1758 ± 180	-	2250 ± 135 **	-	2385± 103**	-
Protein (g)	65 ± 7	15	61 ± 2*	11	64± 3	11
Fat (g)	54± 8	28	40 ± 8**	16	47± 4*	18
Carbohydrate (g)	252± 20	57	412 ± 22**	73	497± 36**	83

t test result between 1 & 2, 1 & 3 ** = Significant at P<0.01 level, * = Significant at P<0.05 level.

Table 6: Impact of carbohydrate supplementation on physical performance of Kabaddi players

	Control (n -12)			*Experimental (n - 12)*		
	Before	*After*	*t test*	*Before*	*After*	*t test*
Speed (sec.)#	8.08 ± 0.54	8.34 ± 0.51	ns	7.48 ± 0.3	7.7 ± 0.32	ns
Strength (cm)	33.28 ± 9.7	32.85 ± 9.3	ns	46.8 ± 9.6	53 ± 8.6	**
Flexibility (cm)	6.28 ± 2.10	6.28 ± 2.40	ns	10 ± 2.9	10.2 ± 3.1	ns
Agility (sec.)#	10.81 ± 0.3	10.78 ± 0.6	ns	10.9 ± 0.49	9.4 ± 0.5	**
Endurance (mt)	864 ±49	900 ±57	ns	832 ±68	1264 ±175	**

#Lesser the value, better the performance ** significant at P<0.01 level.

except speed and flexibility. Carbohydrate supplementation did not show any impact on speed and flexibility performance. Flexibility is the ability to move the body and its parts through a wide range of motion without undue strain to the muscle attachments. Muscle size apparently has very little influence on flexibility Jones (1977). Hence supplementation did not improve flexibility. Saltin et al. (1988) reported that supplementation does not improve high intensity short duration sports because glycogen depletion is not a limiting factor in such activities, so in the present study speed is high intensity and short duration activity, hence there was no improvement after supplementation. Strength is recognized as the most important factor in the physical performance. Strength is very much dependent on body weight and muscular force, Johnson (1986). The performance of repeated strength before Carbohydrate supplement was 46 cm in experimental group. There is significant improvement in strength after carbohydrate supplementation by 7 cms. The agility component is ability to mobilize one's energy effectively in making single or repeated movements requiring a maximum expenditure of force as reported by Clarke and Clarke (1976). The agility performance in seconds of Kabaddi players after carbohydrate supplementation significantly improved (10.9±0.49 seconds to 9.4±0.5 seconds). Endurance is the ability of a muscle to repeat movements against sub maximal resistance or pressure or to maintain a certain degree of tension over time. The endurance performance of experimental group improved significantly after carbohydrate supplementation from 832±68 to 1264±175 meters. Studies by Costas et al. (1997) and John et al. (2003) reported similar findings of improvement in endurance on carbohydrate supplementation in athletes. Another study by Winnick et al. (2005) reveals that carbohydrate feedings resulted in faster repeated 20-mt sprints and higher average jump An Indian study conducted by Khanna and Manna (2005) concluded that carbohydrate supplements during exercise enhanced the performance of athletes.

Field Performance: Field performance as evaluated by three coaches using the specific variables necessary for Kabaddi like offensive and defensive skills like toe touch, hand touch, ankle touch skills are illustrated in the Table 7. All the parameters were significantly better in the experimental group than control group. Scoring of general performance revealed that experimental group was superior (7.6) to the control group (4.2). Number of fouls through out the game was more among control group than in experimental group. Experimental group with carbohydrate supplementation won the match against the control group.

Table 7: Impact of carbohydrate supplementation on the field performance

Attributes	*Control (n -12)*	*Experimental (n 12)*	*t test result*
Toe touch	2.93±0.82	6.07±0.79	**
Hand touch	2.30±0.74	6.05±1.00	**
Ankle touch	2.40±0.76	6.16±1.00	**
No of fouls	9.46±0.54	6.52±0.83	**
General performance	4.2±2.6	7.6±2.9	**

Note: Each attribute was given a maximum of 10 score.
t test result - ** =significant at P<0.01 level.

Fluid replacement with beverage during and after the match in the present study was very effective in improving the performance in the sports. This was also observed in hockey and soccer, Jackson et al (1995). It is attributed that the rest sessions, combined with carbohydrate feeding probably resulted in rapid glycogen synthesis, allowing exercise to continue longer.

***Self-Evaluation*:** As per the opinion of the players, all of them expressed that their overall performance was good due to intervention programme. Only 69 and 31 % of subjects graded their performance as grade 2 and grade 3. All the players informed that nutrition education classes were very useful for them. Details are given in Table 8.

Table 8: Opinion of the experimental group regarding nutrition intervention programme

	Item	*%*
1.	Over all Performance was better due to interventionprogramme	100
2.	Self evaluation of performance during the competition.	
	Grade 1	00
	Grade 2	69
	Grade 3	31
3.	Supplementation of snacks were good before the event	87
4.	Beverage during competition improved performance	87
5.	Nutrition education classes were useful	75

Majority (87%) of them opined that supplementation of snack and drink improved their performance. They also expressed that they perceived the importance of nutrition along with training and practice in team game.

CONCLUSION

Nutrition education and carbohydrate supplementation helped the Kabaddi players to improve their performance as revealed by their nutrition knowledge and practice, physical and field performance. Further studies may have to be conducted to standardize techniques to evaluate Sports performance in relation to nutrition and other environmental factors. The present study suggests that the importance of nutrition in sports should reach all sports personnel involved in athletics and other team games in order to maximize their performance.

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